nScrypt™
WRITING THE FUTURE

nScrypt™
Writing the Future

Jim Story, President

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The Company

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Company history

- *nScrypt* is a wholly owned subsidiary of Sciperio
- Sciperio, working with the US Government Defense Advanced Research Projects Agency (DARPA), developed precision dispensing technology
- In 2002 Sciperio started *nScrypt* to commercialize the technology
- 2003 *nScrypt* developed pump, pump controller and motion platform products
- First hardware sales in Q4, 2003

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What do we do that is unique?

- Deposit small feature sizes
- Deposit patterns without the need for templates or masks
- Deposit on conformal (nonlinear) surfaces
- Deposit a wide range of viscosities (1 to 1 million cp)
- Gentle dispensing process
- OFFER THESE DISPENSING ABILITIES IN COMBINATION WITH COMPLETE AUTOMATED PLATFORMS AND SUPPORT SERVICES

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What is small?

- Lines: less than 150 microns in width
  - Normally can deposit 75 micron width and 35 micron height
  - Have deposited 25 microns wide under special conditions
- Dots: Less than 200 microns in diameter
  - 100 micron diameter with good repeatability
  - 50 micron diameter has been achieved

25 microns = .001 inch. A human hair is about 75 microns

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Applications

- Lines
  - Straight
  - Curved
  - Conformal
- Dots
  - Bumps
  - Lenses
  - Via fill
- Layers
  - Lines and Dots
- Blends (Gradients)
  - Active mixing
  - Passive mixing

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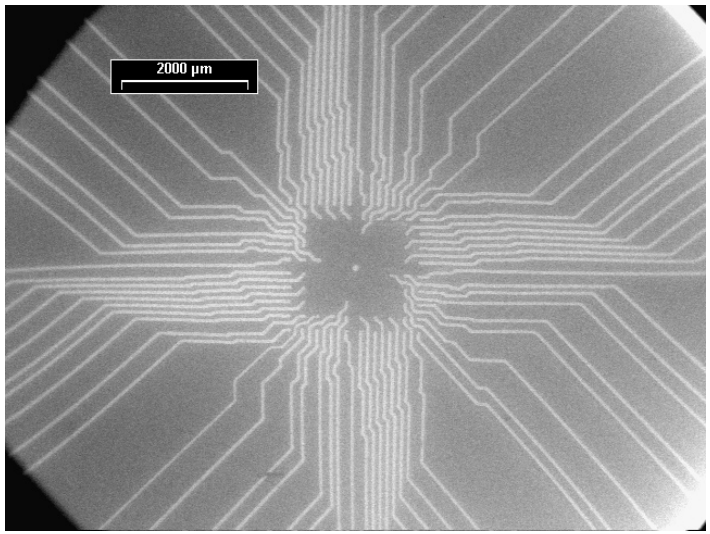
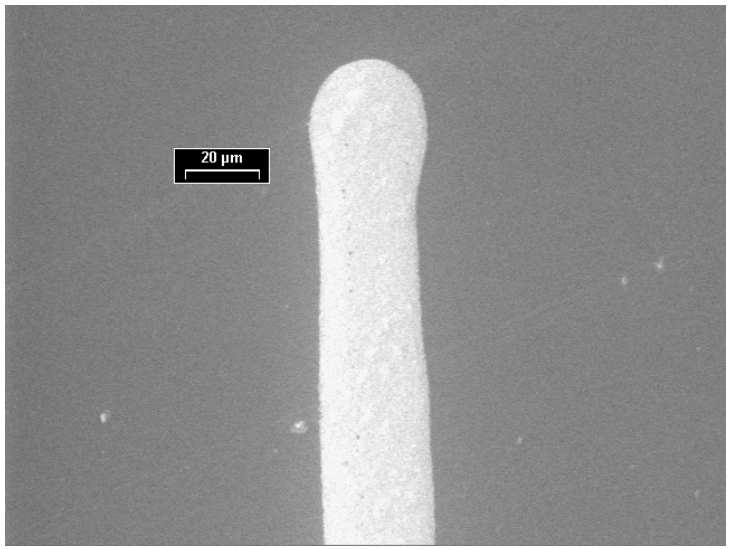
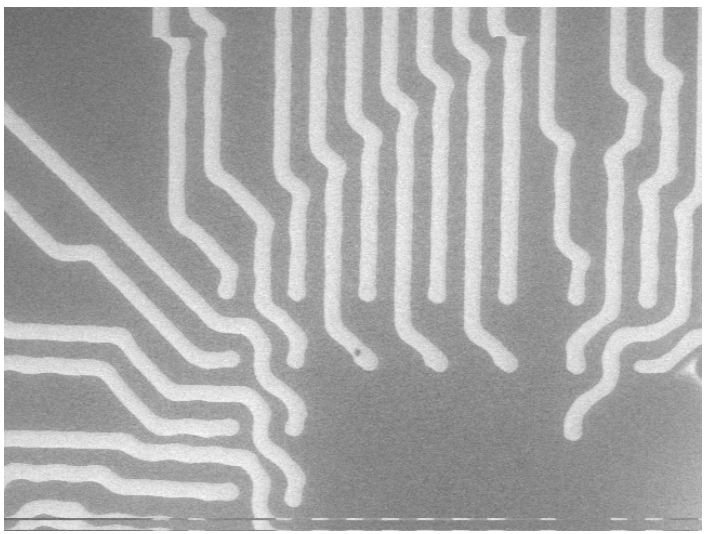
Examples

Lines

Lines and patterns







- Small geometries
- Complex patterns (From CAD files)
- 75 microns (25 microns demonstrated)

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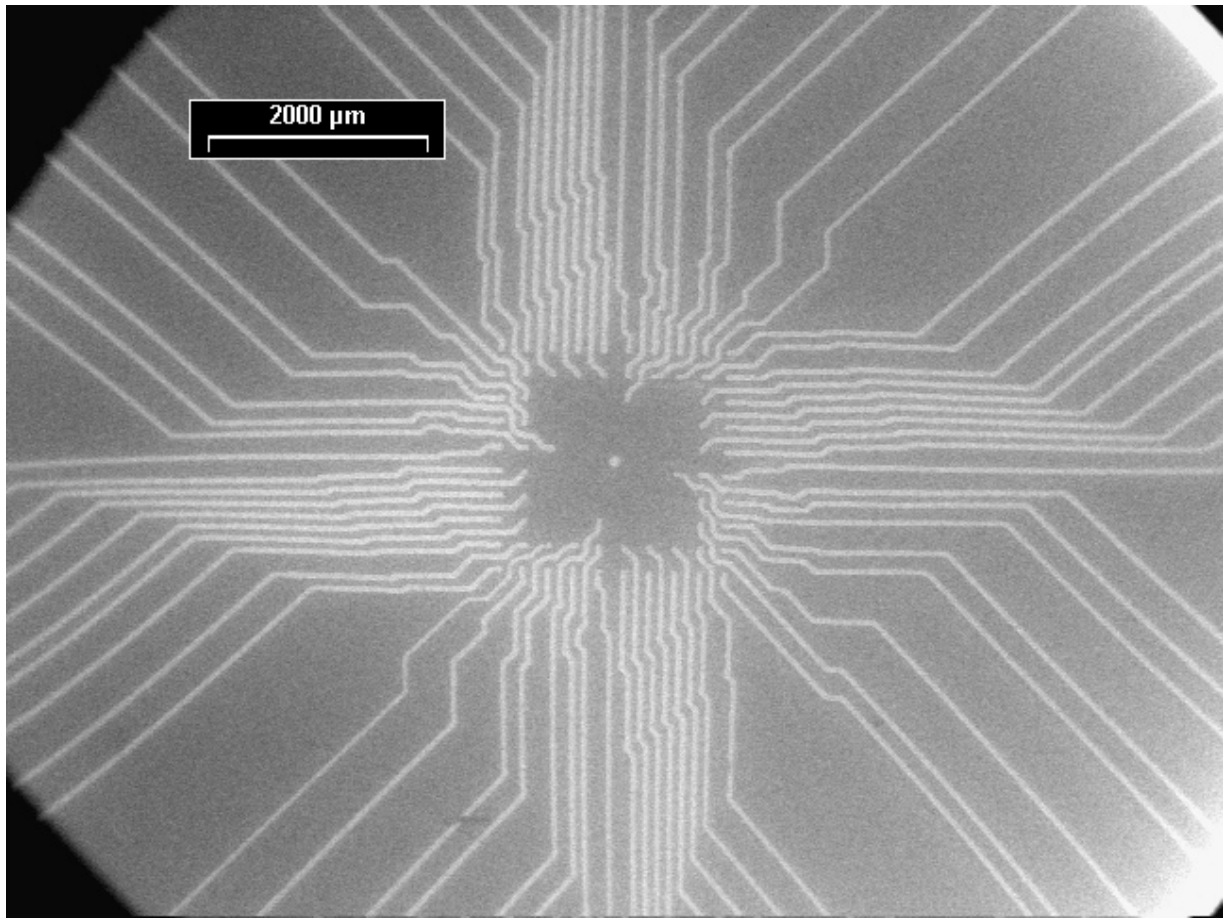
Breakout Pad



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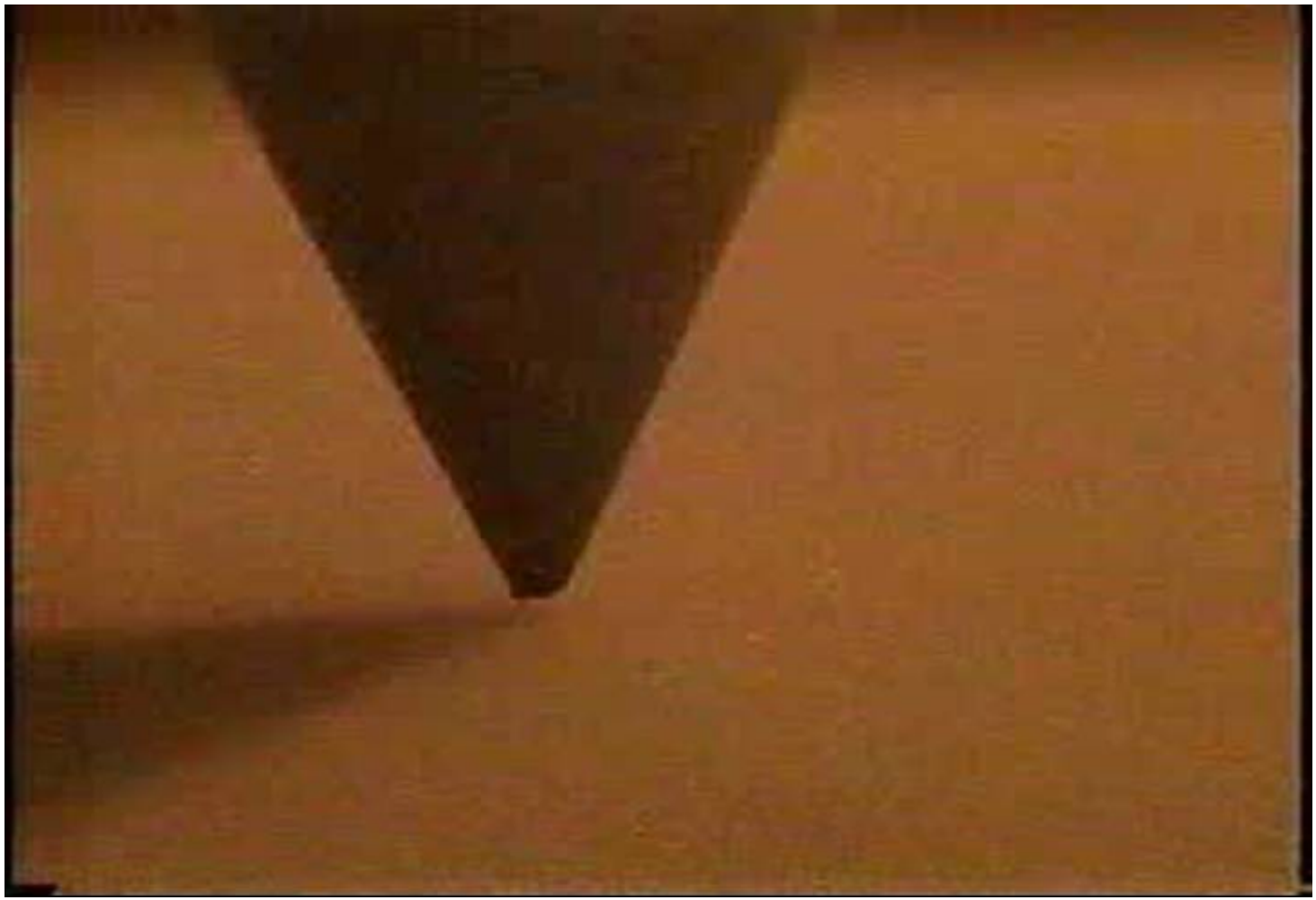
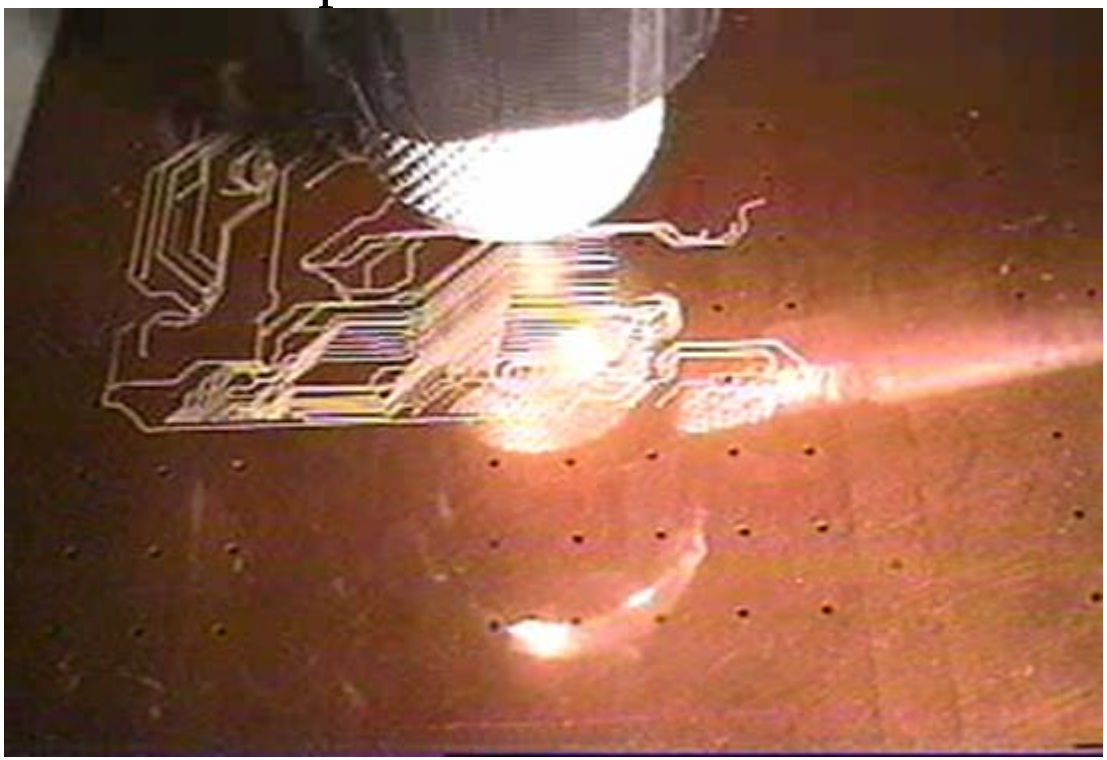
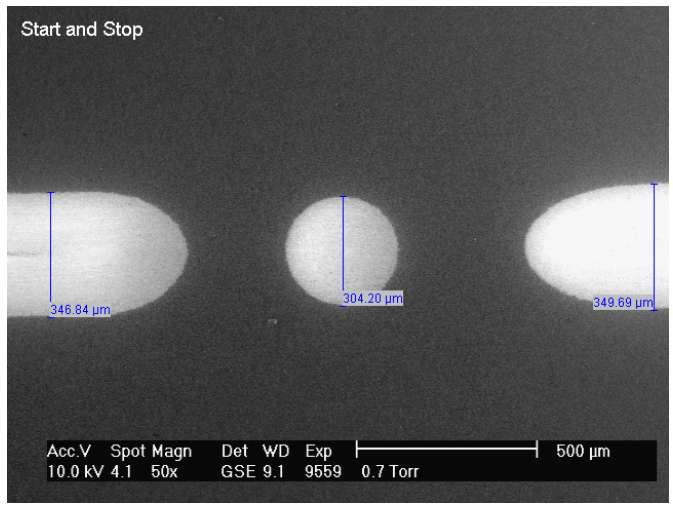
Writing breakout pattern



Precision starts and stops

The key is the ability to start and stop the flow with precision control





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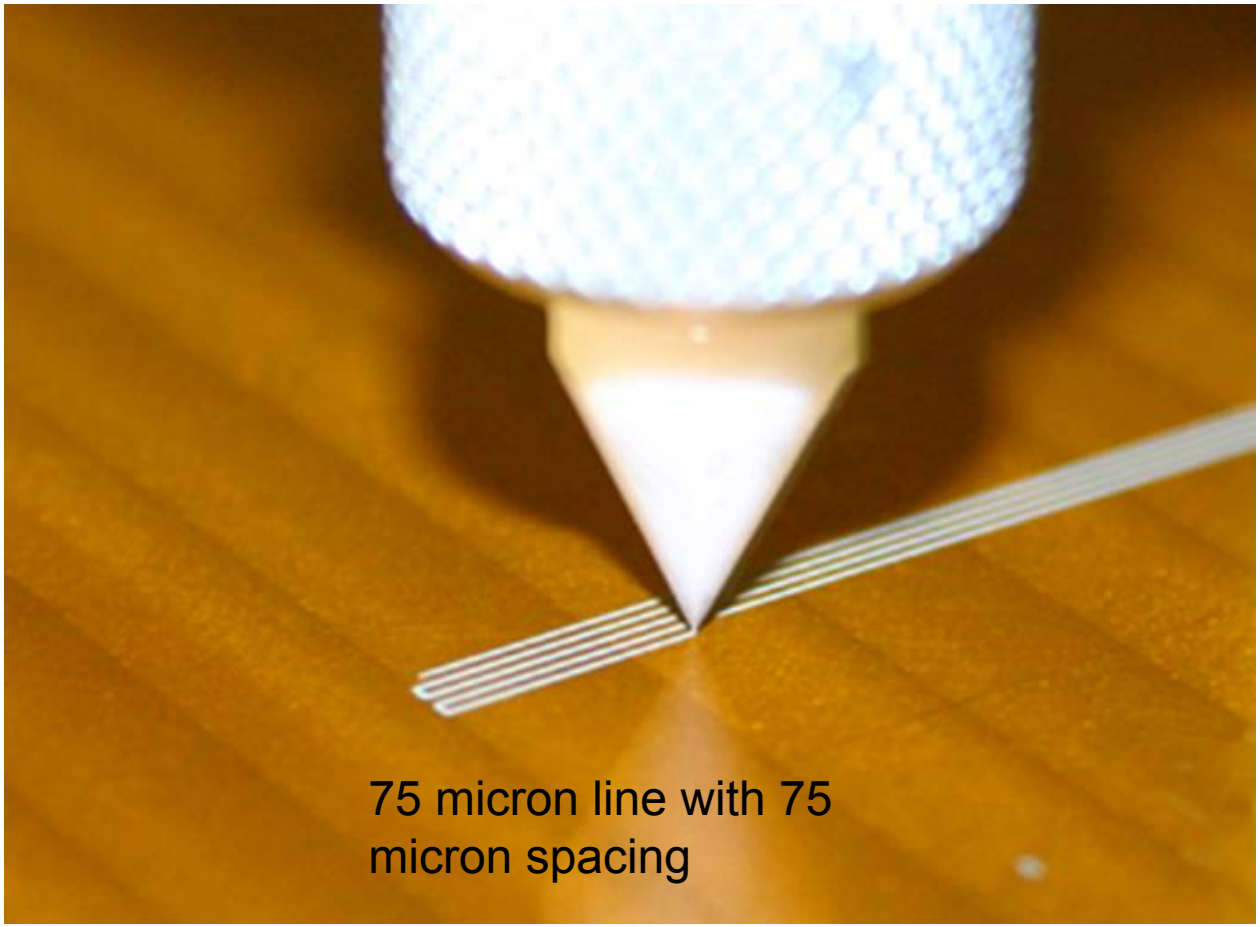
Conductive low temperature ink on Kapton



75 micron line with 75 micron spacing

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Resistor pads and lines

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Dispensing solder lines

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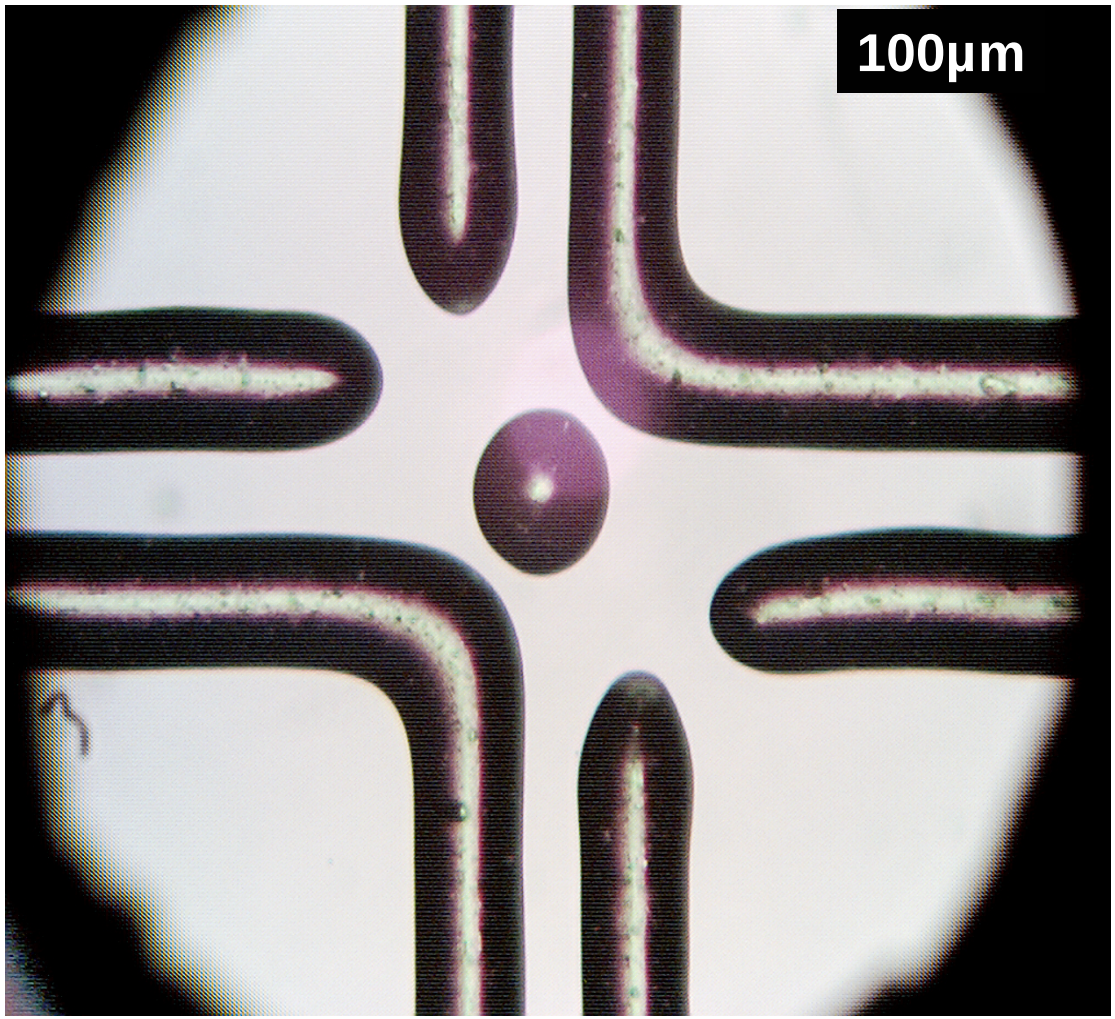
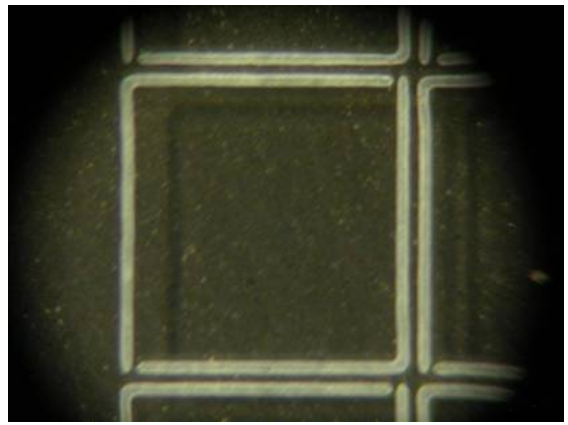
Adhesive on glass





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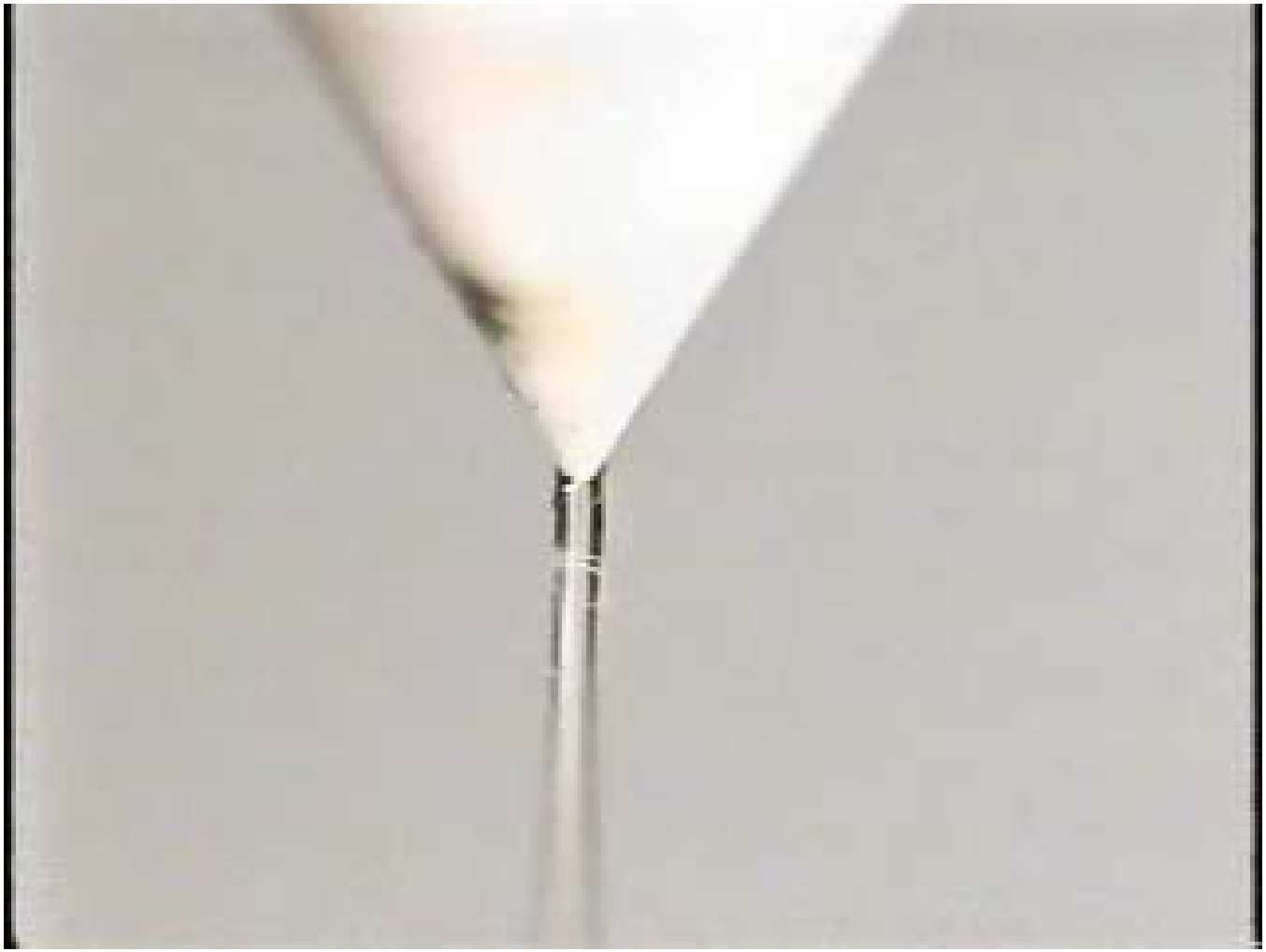
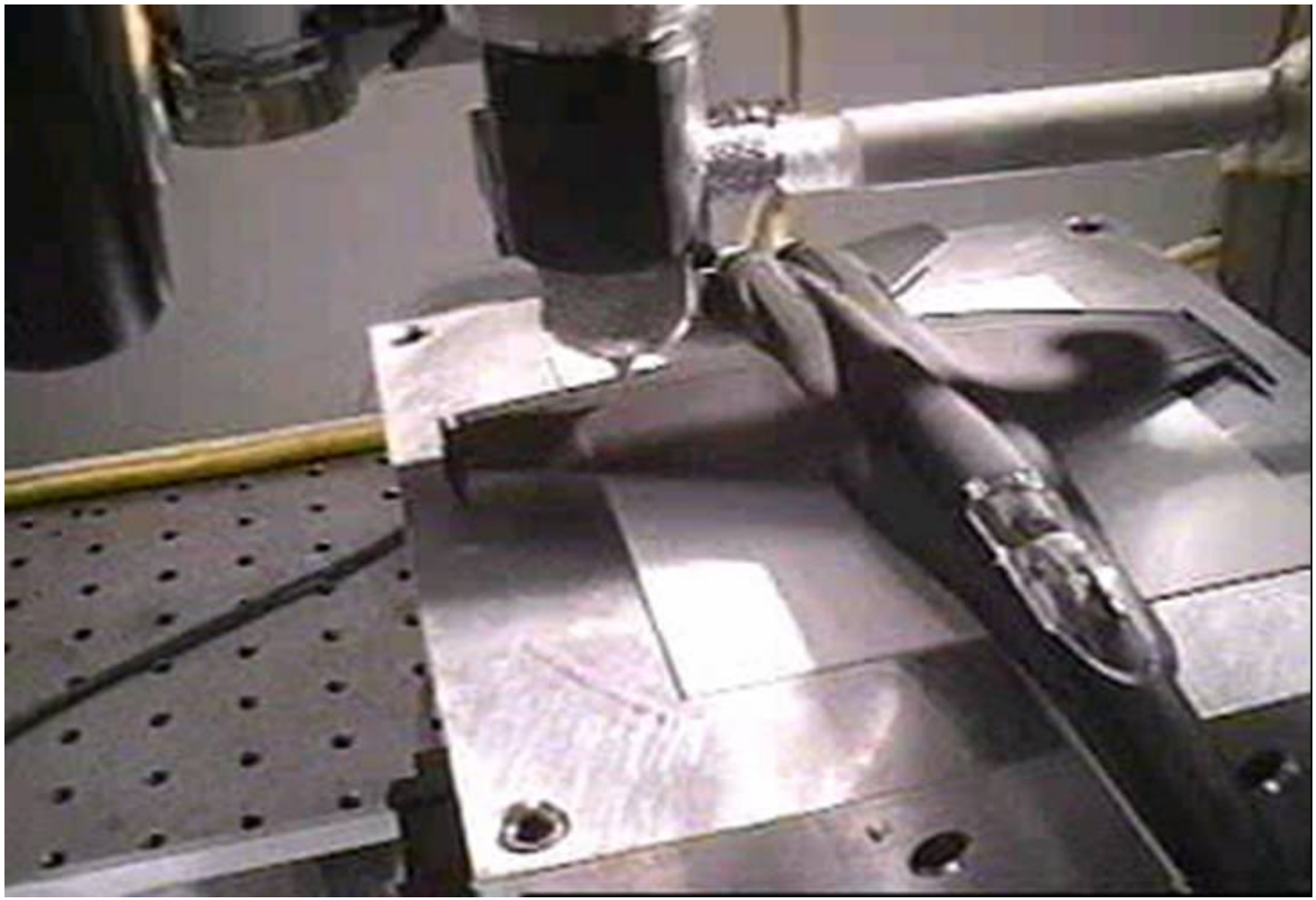
75 micron line onto a 250 micron diameter shaft



Conformal Dispensing

Surface premapped using nScrypt Smart Z product



Writing conformal lines

Dynamic height sensing – product in development stage

Sensing location and writing on a fly's wing

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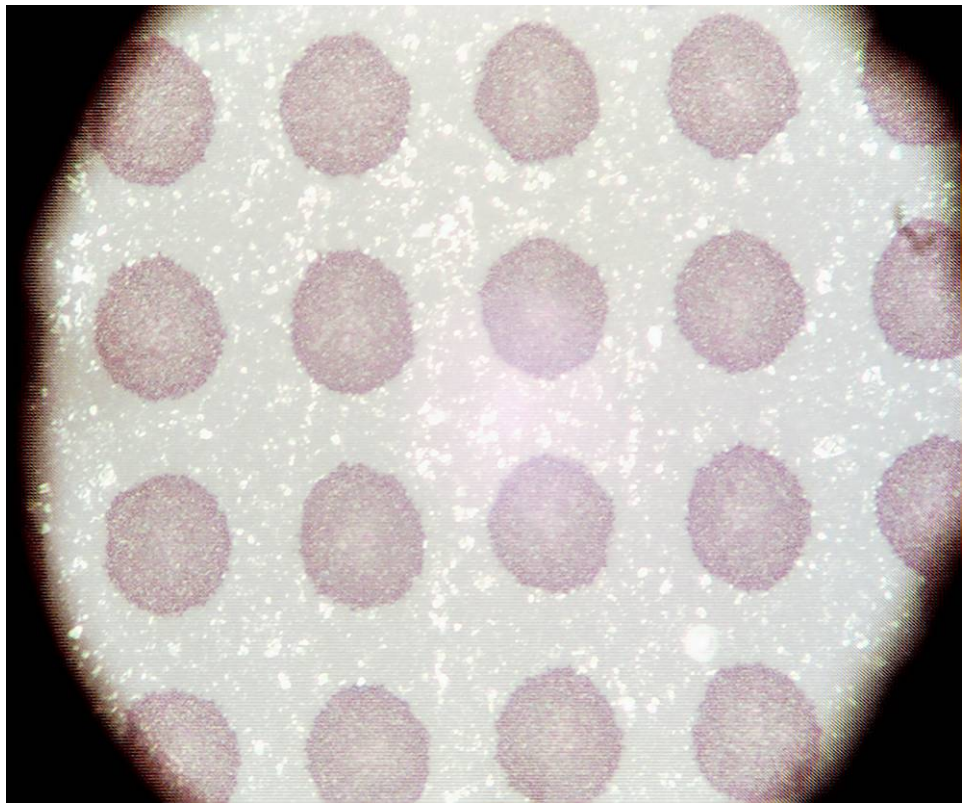
Examples

Dots

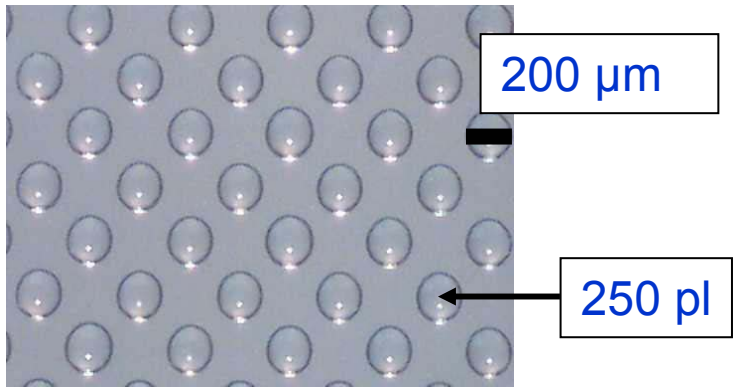
100 micron dots with conductive ink

100 micron OD x 10 micron tall
(75 Pico liter)



Micro assays

- Gene, Protein, Cell, Tissue
- Bio-Adhesives : fibrin glue



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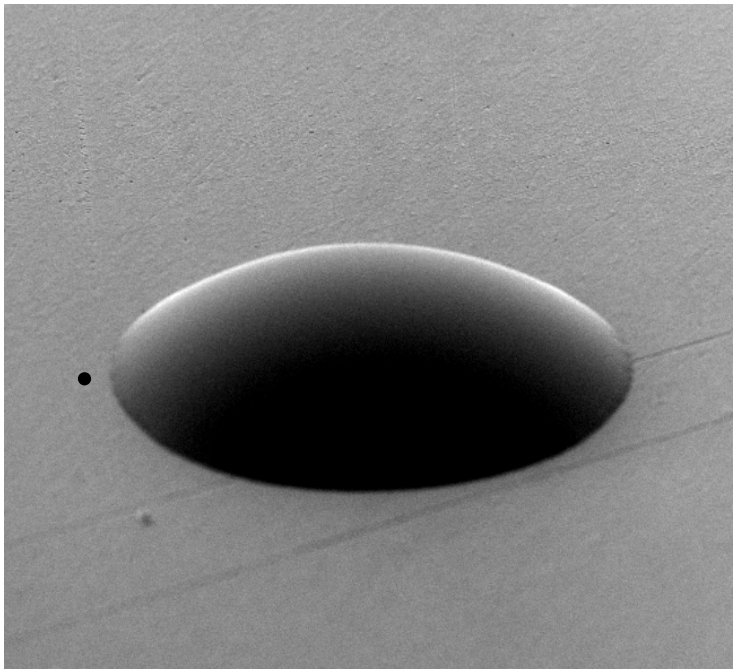
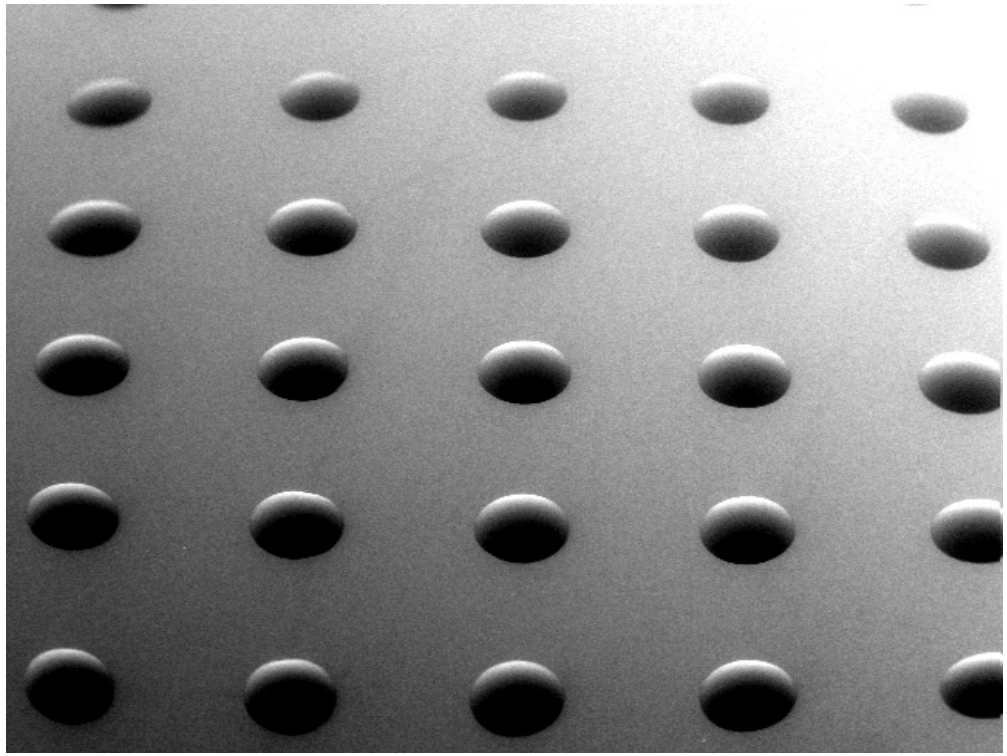
Micro lenses





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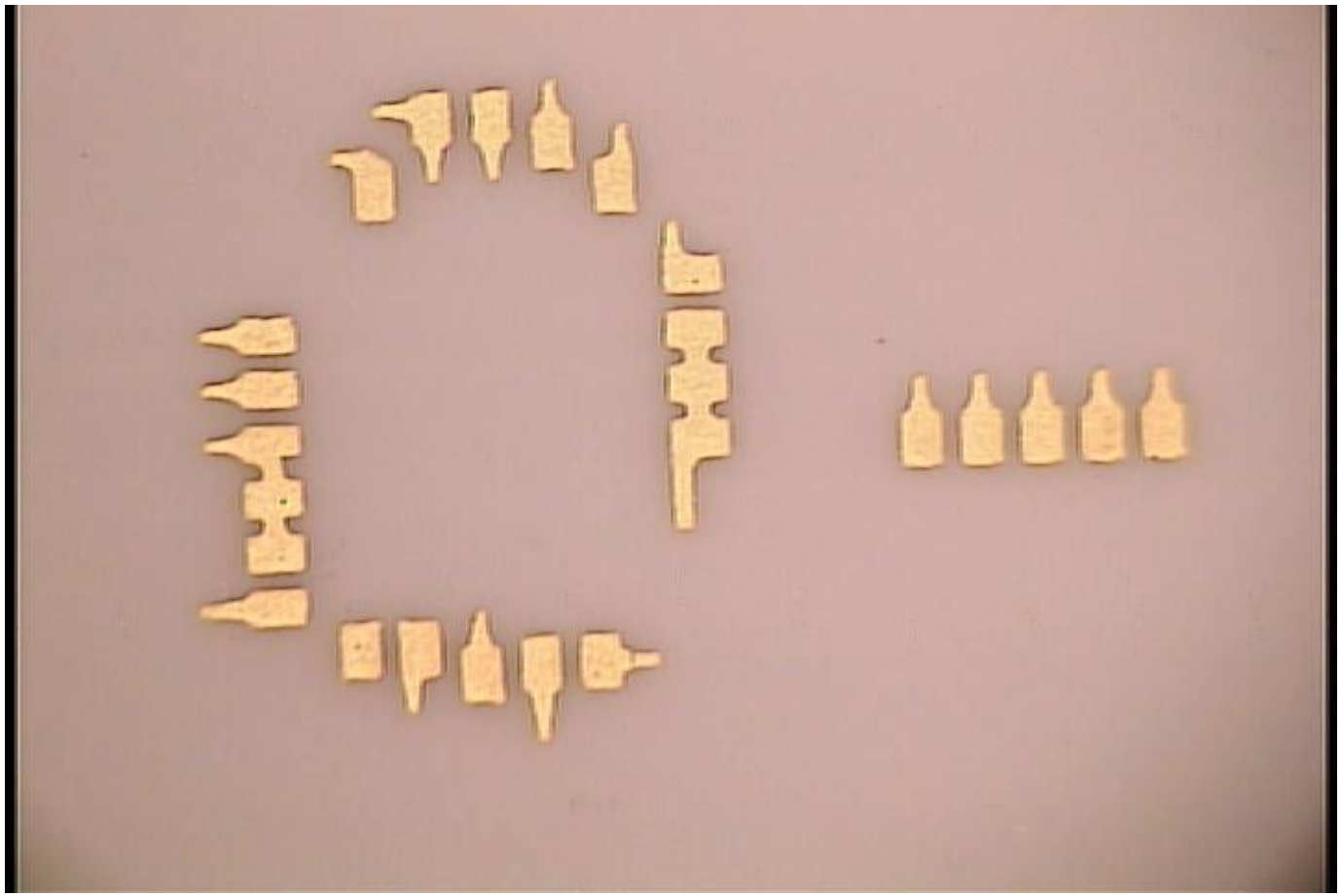
Gold pads



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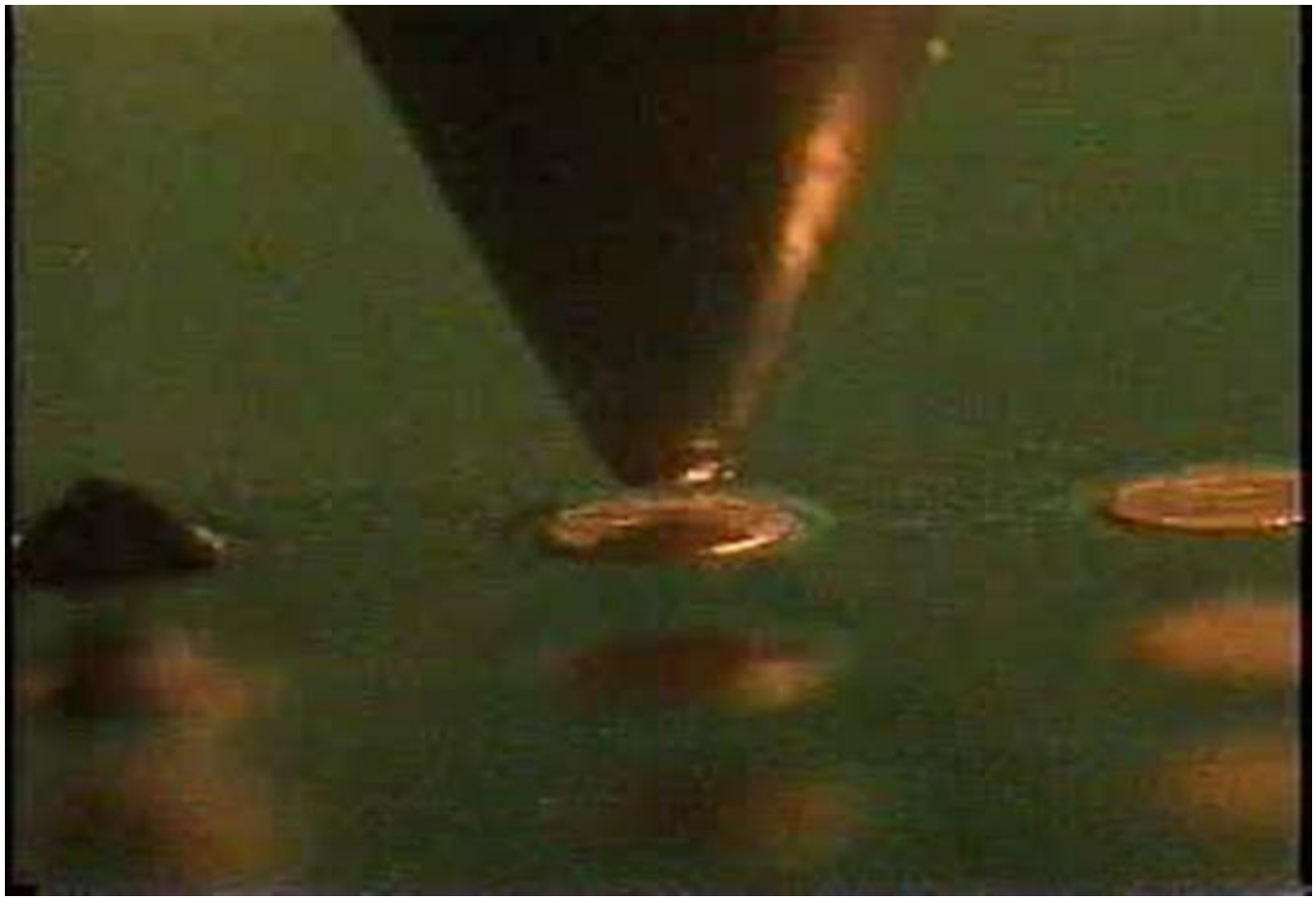
Dispensing solder balls



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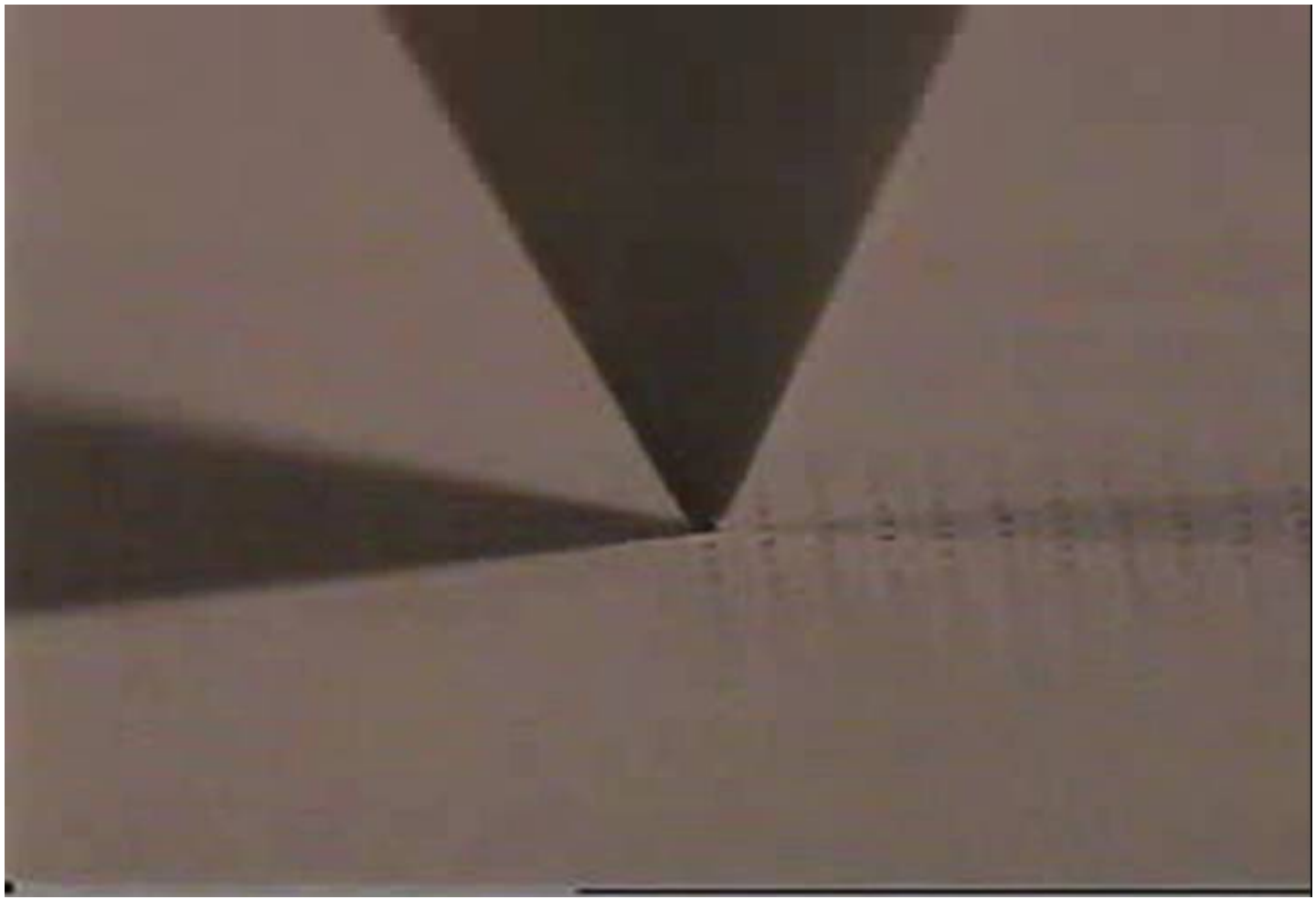
Via filling



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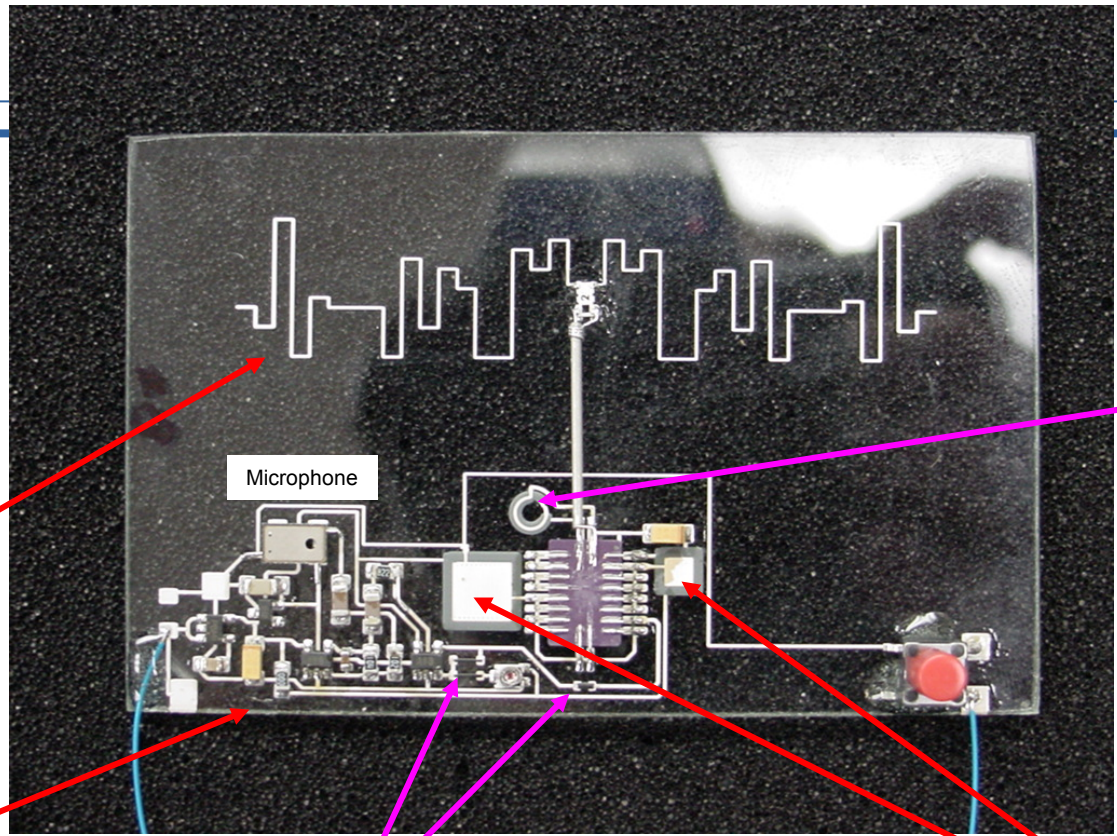
Examples

Layers

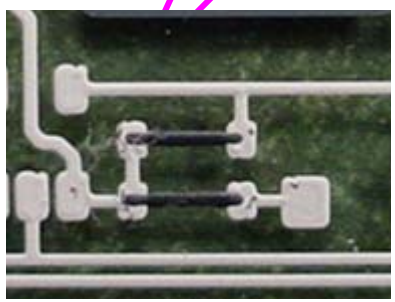
Directly-Written transmitter components



916MHz, 50Ω
Stochastic Dipole
50% size reduction

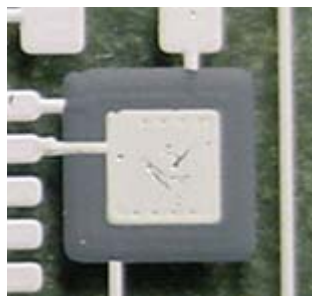
Parallel Resonant
LC network (ESD shunt)

"WCB"
Written Circuit Board
Sintered silver particles
on glass

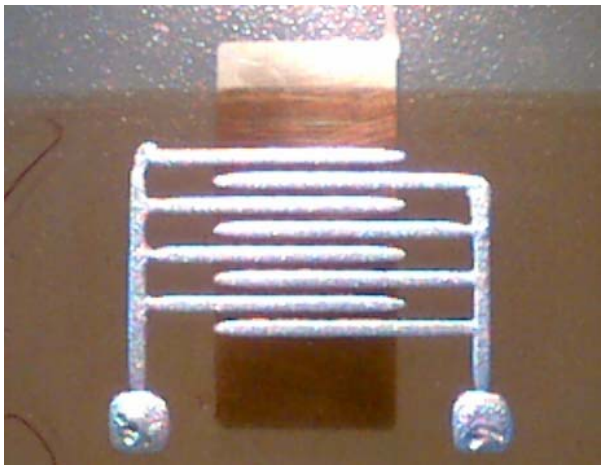


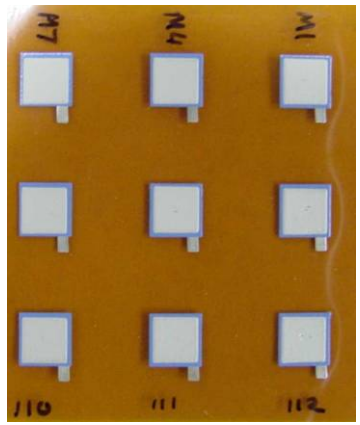
20K resistors (two-left)
3K resistor (right)

<u>Multi-leaded</u> Capacitors
100pF capacitor (left)
25pF capacitor (right)



Examples

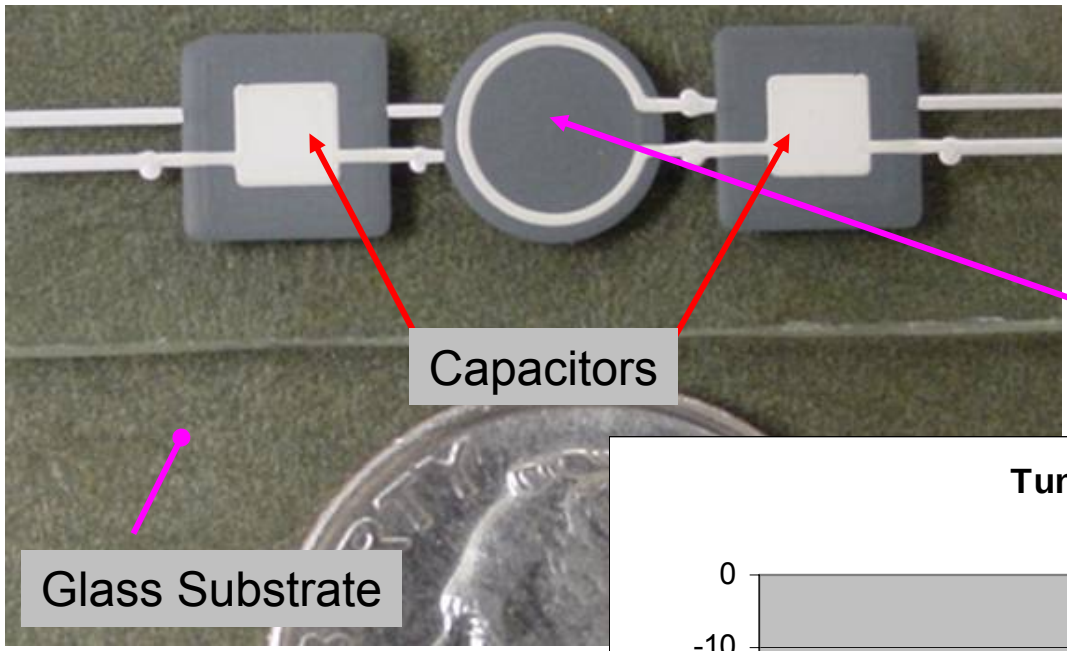


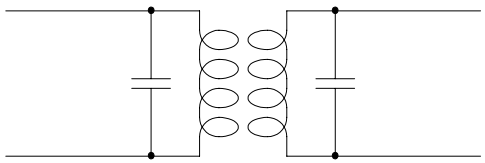


Conductors
Resistors
Capacitors
Inductors
Adhesives
Actives
Polymers
Battery
Biology

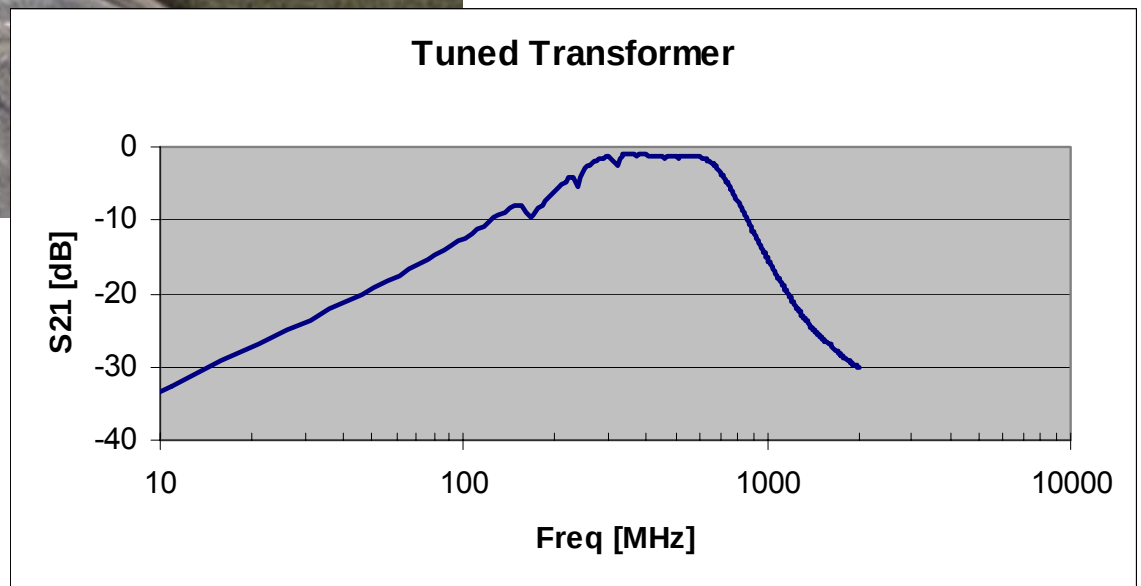
Passive RLC components

400MHz Tuned RF Transformer



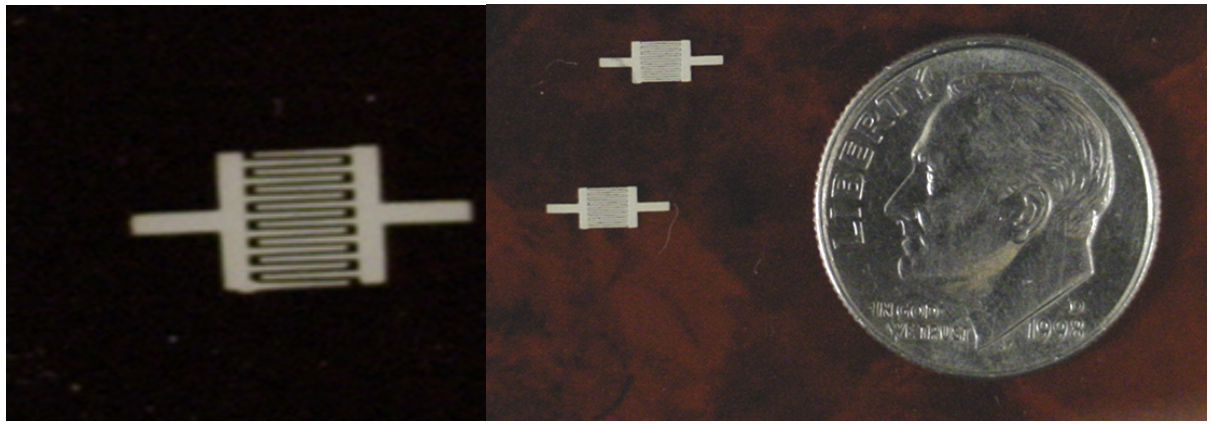


Equivalent Circuit

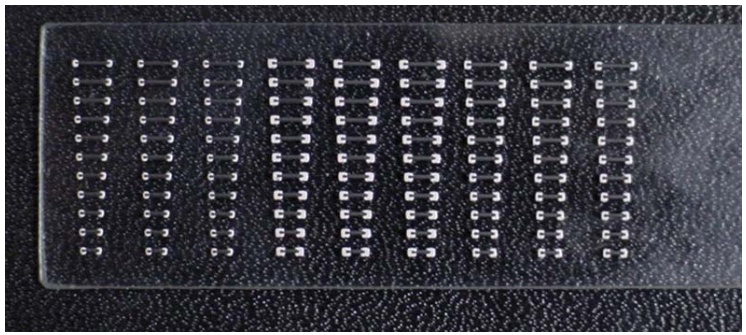


Passive RLC components

15nH two-turn inductor
Kapton substrate, 0.005”
0.150” diameter

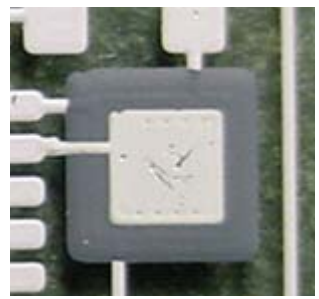


1pF Microstrip Interdigitated capacitor, 0.005” Kapton Film Substrate



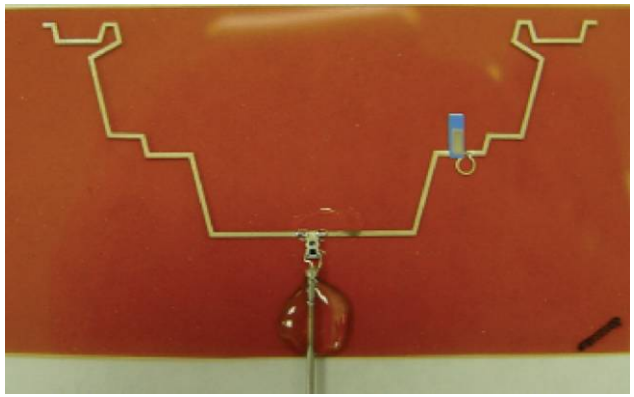
Resistor array on microscope slide

LC network designed for shunt LC resonance at 1.1GHz

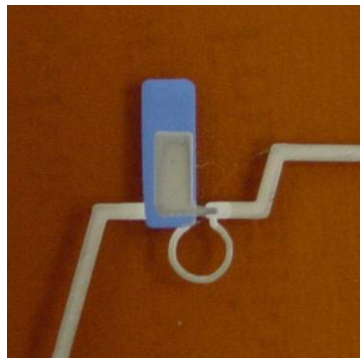


25pF Multi-leaded RF bypass capacitor

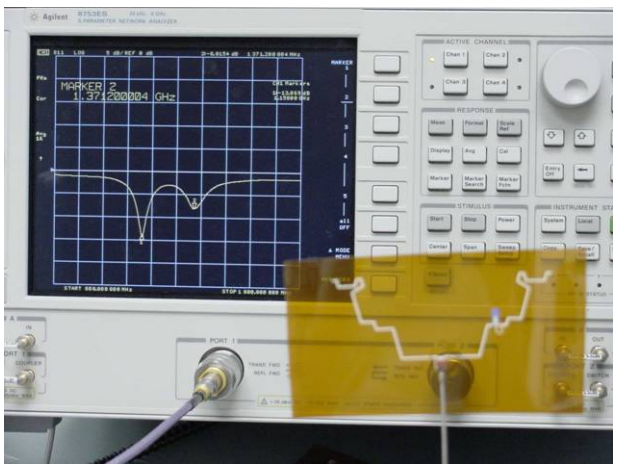
Dual band GPS antenna on Kapton



Antenna with LC load & 0603 chip balun
Silver & dielectric on 0.005” Kapton film



Close-up of LC load. This capacitor was designed to be tuned by trimming with a femtosecond laser



Return loss test on Agilent 8753ES VNA

Silver applied to 5mil Kapton, bent into a 3/8” diameter cylinder

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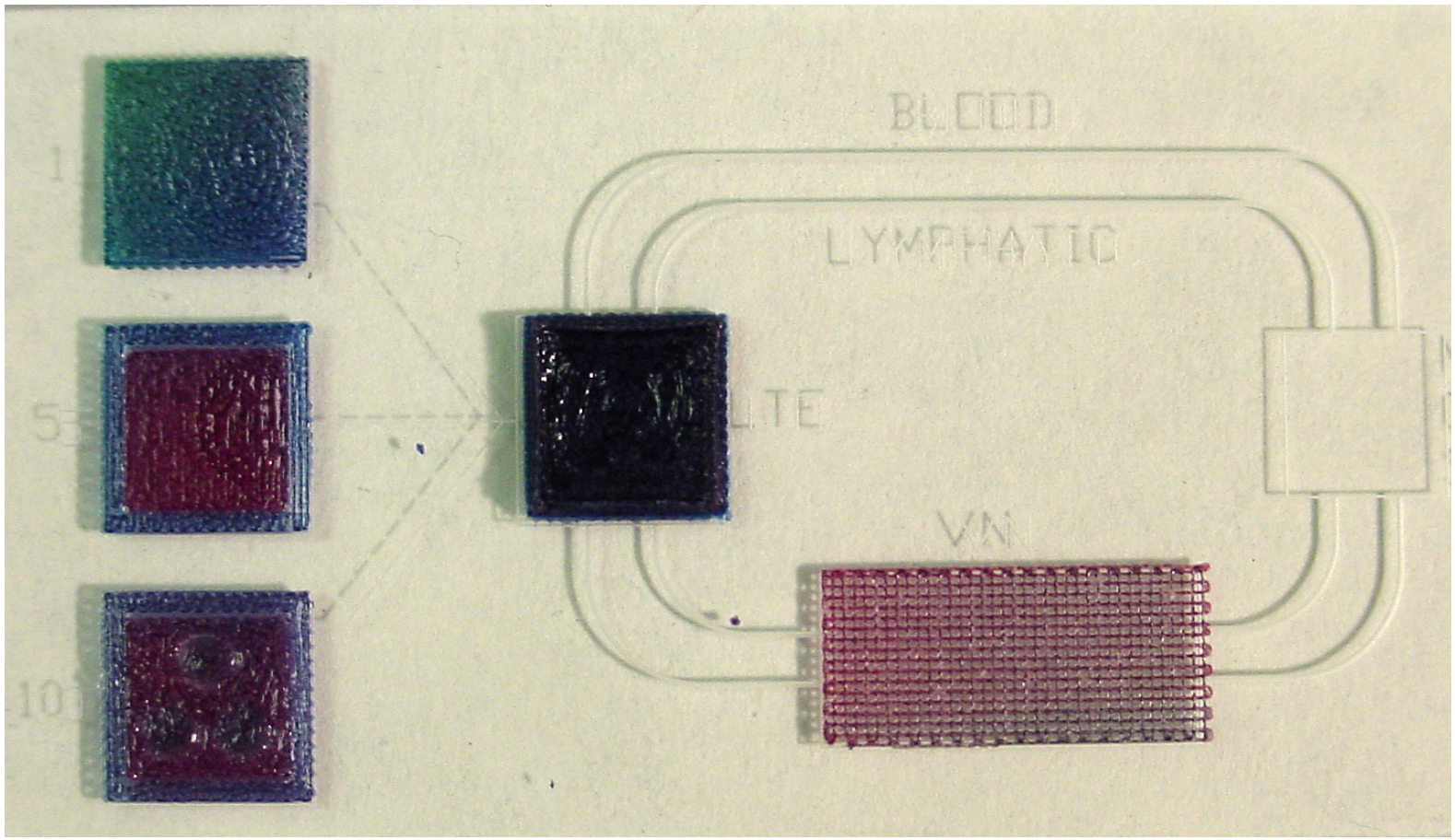
11 layer bio construction with multiple materials per layer



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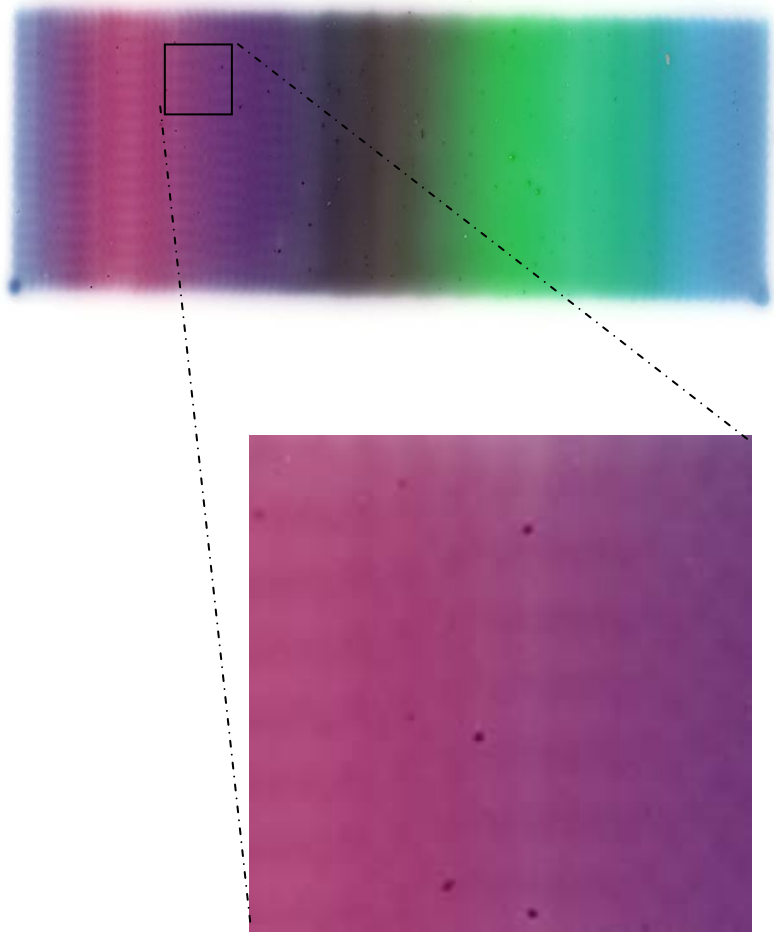
Examples

Blending and Gradients
(Active Mixing)

Active mixing

- Macro-scale (1 mm and up)
  - Gradient transition
  - Non-defined line transient
- Micro-scale (1 mm and below)
  - No line segregation
  - Continuous color gradient
  - Homogenous mixing



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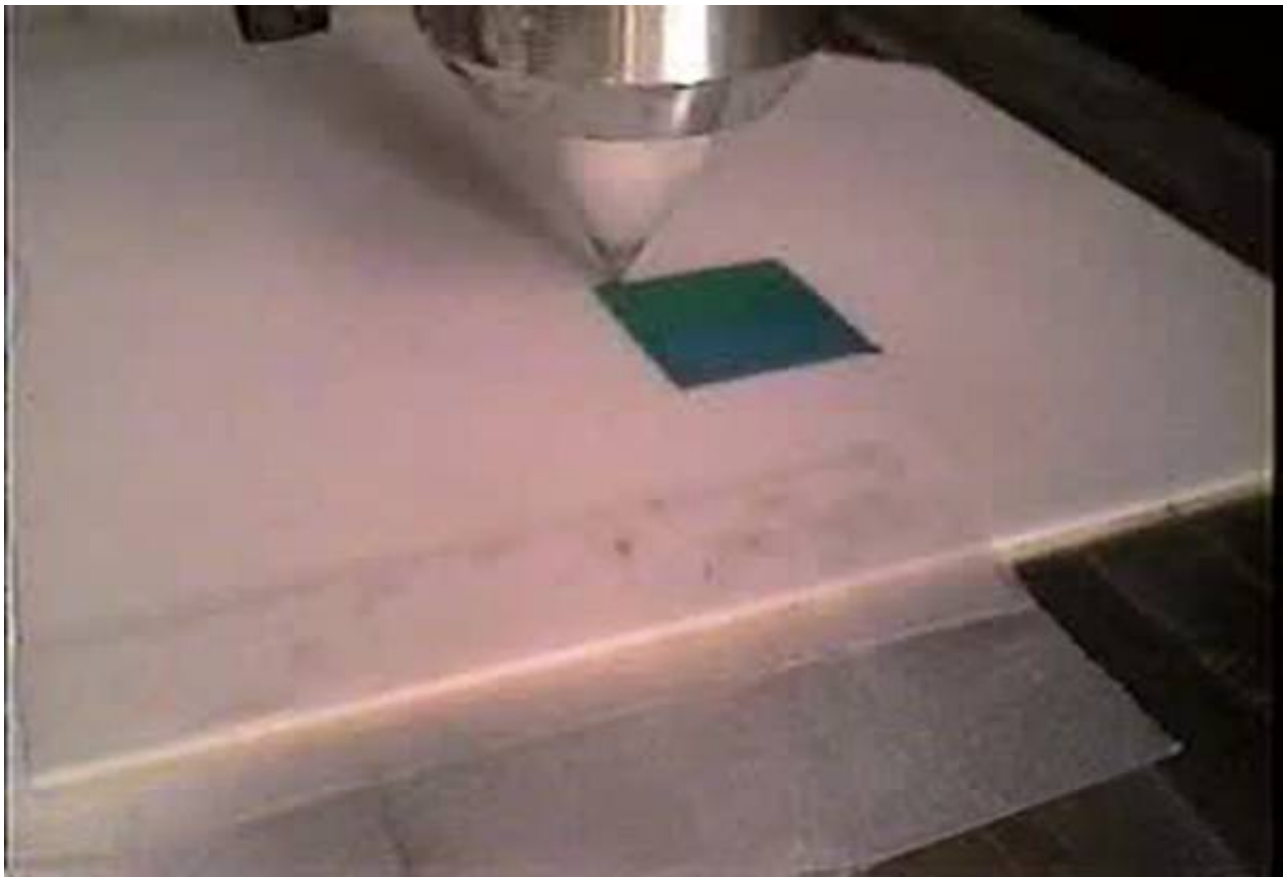
Active mixing deposition



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Direct Writing Pattern with Gradient fills

nScrypt Products

- Motion Platforms
- Smart Pump System
- Smart Z System
- Process Development
- Contract Manufacturing (direct writing)

Motion platforms

Other configurations available – please contact nScrypt

- Model 3De - 300 – HP
  - 300mm x 300mm x 100mm
  - 1 micron repeatability
  - 300 mm/sec in x and y
  - 100 mm/sec in z
- Model 3De – 600 – HP
  - 600mm x 600mm x 300mm
  - 1 micron repeatability
  - 300mm/sec

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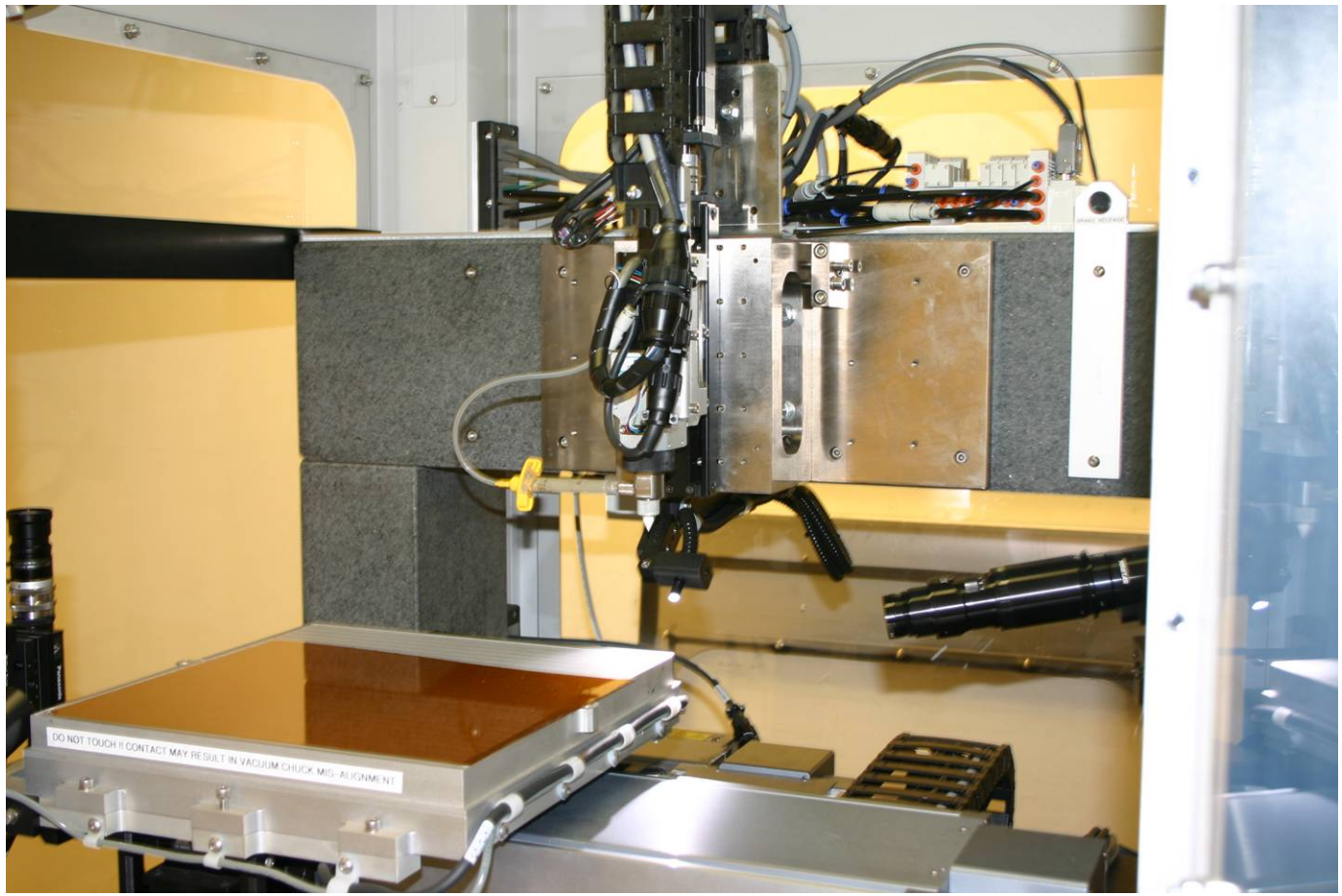
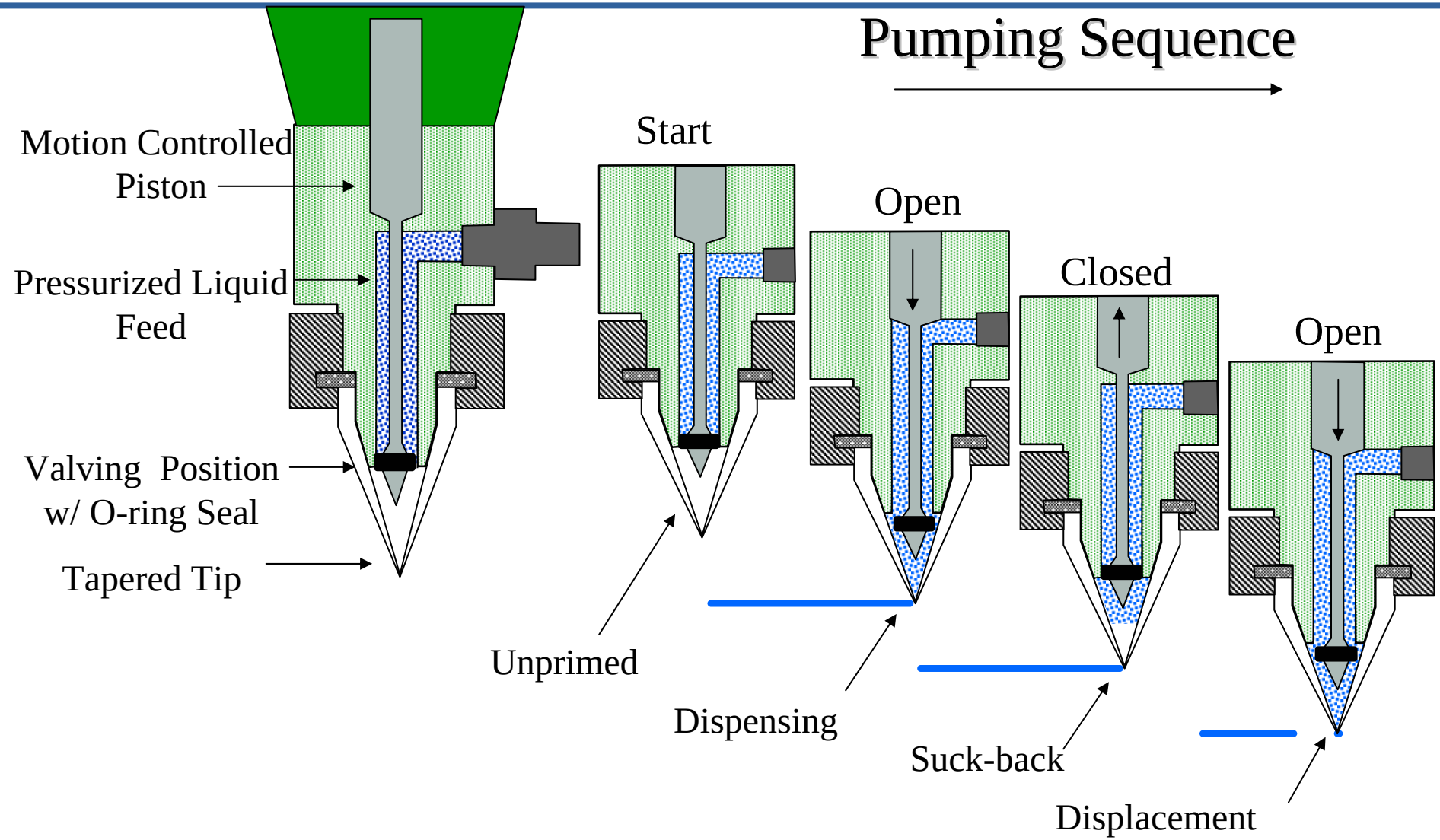
Motion stages: 3DE – 300 - HP



Servo actuated precision pump

Valve operation

Computer controlled piston actuation.



Smart Pump dispensing system

Dispensing problems addressed by the *nScrypt* systems

- Small feature sizes – Lines 50µm and larger
- Dots – 50µm and larger in diameter
- Uniform Start/Stop Eliminate puddles and irregular end points (“dairy queen effect” or bump at line termination)
- Uniform line width
- Uniform line Thickness
- Uniform dispensed volume
- When used in conjunction with the **Smart Z** axis, the system can write on conformal surfaces

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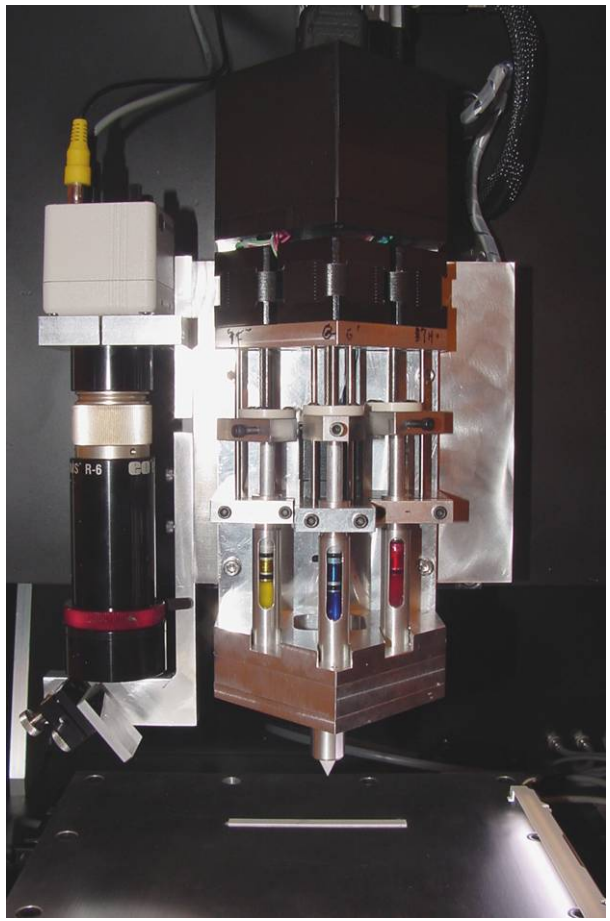
Blending pump with three materials

(not released for production)



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